

THAT WHICH IS CLAIMED IS:

1. A method of recovering from a failure of a primary routing communication protocol stack which routes communications over connections to a virtual Internet Protocol address (VIPA) and at least one port associated with the VIPA to a plurality of other communication protocol stacks associated by the routing communication protocol stack with the VIPA and the at least one port, the method comprising:

identifying at least one of a plurality of communication protocol stacks other than the primary routing communication protocol stack in a cluster of data processing systems containing the primary routing communication protocol stack as a backup routing communication protocol stack;

storing at the backup routing communication protocol stack an identification of communication protocol stacks associated with the VIPA and the at least one port as candidate target stacks;

receiving messages at the backup routing communication protocol stack identifying ones of the communication protocol stacks having application instances bound to the VIPA and listening on the at least one port as current actual target stacks;

identifying connections to the VIPA and the at least one port for current actual target stacks;

constructing a routing table from the received messages identifying the connections to the VIPA so as to provide routing path information to current actual target stacks associated with the connection; and

routing messages on the connections to the VIPA and the at least one port to the current actual target stacks associated with the connections through the backup

routing communication protocol stack utilizing the  
constructed routing table.

2. A method according to Claim 1, wherein the step  
of identifying connections to the VIPA comprises the step  
of receiving messages from the current actual target  
stacks identifying connections to the VIPA and the at  
least one port associated with the current actual target  
stacks.

3. A method according to Claim 1, further  
comprising the step of:

receiving a list of communication protocol stack  
addresses which are associated with the VIPA and the at  
least one port; and

wherein the step of storing at the backup routing  
communication protocol an identification of communication  
protocol stacks associated with the VIPA and the at least  
one port as candidate target stacks comprises the step of  
storing the received list of communication protocol stack  
addresses.

4. A method according to Claim 3, wherein the list  
further includes identification of the VIPA and ports  
associated with the VIPA.

5. A method according to Claim 1, further  
comprising the step of:

defining, at the backup routing communication  
protocol stack, an identification of communication  
protocol stacks which are associated with the VIPA and  
the at least one port so as to provide a backup list of  
candidate target stacks which is different from the  
candidate target stacks of the primary routing  
communication protocol stacks; and

wherein the step of storing at the backup routing communication protocol an identification of communication protocol stacks associated with the VIPA and the at least one port as candidate target stacks comprises the step of storing the backup list of candidate target stacks.

6. A method according to Claim 5, wherein the communication protocol stacks identified in the backup list of candidate target stacks are selected to reduce disruption of the cluster of data processing systems associated with the communication protocol stacks by failure of the primary routing communication protocol stack.

7. A method according to Claim 1, further comprising the step of sending the stored list to the plurality of communication protocol stacks in the cluster of data processing systems.

8. A method according to Claim 7, wherein the communication protocol stacks in the cluster of data processing systems carry out the following steps responsive to receiving the list from the backup routing communication protocol stack:

transmitting messages to the backup routing communication protocol stack identifying ones of the communication protocol stacks in the cluster of data processing systems which are identified on the list and which have application instances bound to the VIPA and listening on the at least one port;

transmitting messages to the backup routing communication protocol stack identifying connections to the VIPA and the at least one port; and

associating the backup routing communication protocol stack with the VIPA and the at least one port so

as to send subsequent messages associated with the VIPA and the at least one port to the backup routing communication protocol stack.

5           9. A method according to Claim 1, further comprising the steps of:

          detecting recovery of the primary routing communication protocol stack; and

10           transferring routing of connections to the VIPA and the at least one port back to primary routing communication protocol stack upon detection of recovery of the primary routing communication protocol stack.

15           10. A method according to Claim 9, wherein the steps of detecting recovery and transferring routing comprise the steps of:

20           receiving, at the backup routing communication protocol stack, an identification of communication protocol stacks associated with the VIPA and the at least one port which are being routed by the backup routing communication protocol stack from the primary routing communication protocol stack;

25           associating the primary routing communication protocol stack with the VIPA and the at least one port at communication protocol stacks having connections to the VIPA and the at least one port or identified in the identification from the primary routing communication protocol stack as associated with the VIPA and the at least one port so as to cause subsequent messages  
30           associated with the VIPA and the at least one port to be sent to the primary routing communication protocol stack;

          identifying connections to the VIPA and the at least one port which are routed by the backup communication protocol stack;

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constructing a routing table at the primary routing communication protocol stack from the received identification of the connections to the VIPA so as to provide routing path information to current actual target stacks associated with the connection; and

routing messages on the connections to the VIPA and the at least one port to the current actual target stacks associated with the connections through the primary routing communication protocol stack utilizing the constructed routing table.

11. A method of recovering from a failure of a primary routing communication protocol stack which routes messages to a predefined virtual IP address (VIPA) to a predefined set of candidate target communication protocol stacks, the method comprising:

defining a backup routing communication protocol stack which takes ownership of routing functions for the VIPA in the event of failure of the primary routing communication protocol stack;

detecting failure of the primary routing communication protocol stack;

determining, at the backup routing communication protocol stack, connections to the VIPA which are associated with the primary routing communication protocol stack;

routing the determined connections to communication protocol stacks associated with the connections through the backup routing communication protocol stack;

establishing a second set of candidate target communication protocol stacks which is different from the predefined set of candidate target communication protocol stacks and associated with the backup routing communication protocol stack;

receiving a request for a new connection to the  
VIPA;

selecting a communication protocol stack from the  
second set of candidate communication protocol stacks as  
5 a destination for the new connection to the VIPA; and

routing messages associated with the new connection  
to the selected communication protocol stack through the  
backup routing communication protocol stack.

10 12. A method according to Claim 11, wherein the  
second set of candidate target communication protocol  
stacks are selected to reduce disruption of a cluster of  
data processing systems associated with the communication  
protocol stacks by failure of the primary routing  
15 communication protocol stack.

13. A method according to Claim 11, further  
comprising the step of sending an identification of the  
second set of candidate target communication protocol  
20 stacks to other communication protocol stacks in a  
cluster of data processing systems.

14. A method according to Claim 13, wherein the  
other communication protocol stacks carry out the  
25 following steps responsive to receiving the second set of  
candidate target communication protocol stacks from the  
backup routing communication protocol stack:

transmitting messages to the backup routing  
communication protocol stack identifying ones of the  
30 other communication protocol stacks which have  
application instances bound to the VIPA and listening on  
a port of the VIPA;

transmitting messages to the backup routing  
communication protocol stack identifying connections to  
35 the VIPA; and

associating the backup routing communication protocol stack with the VIPA so as to send subsequent messages associated with the VIPA and the at least one port to the backup routing communication protocol stack.

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15. A method according to Claim 11, further comprising the steps of:

detecting recovery of the primary routing communication protocol stack; and

10 transferring routing of connections to the VIPA back to primary routing communication protocol stack upon detection of recovery of the primary routing communication protocol stack.

15 16. A method according to Claim 15, wherein the steps of detecting recovery and transferring routing comprise the steps of:

receiving, at the backup routing communication protocol stack, an identification of candidate target communication protocol stacks associated with the VIPA from the primary routing communication protocol stack;

20 associating the primary routing communication protocol stack with the VIPA at communication protocol stacks having connections to the VIPA or identified in the received identification of candidate target communication protocol stacks from the primary routing communication protocol stack so as to cause subsequent messages associated with the VIPA to be sent to the primary routing communication protocol stack;

25 identifying connections to the VIPA which are routed by the backup communication protocol stack;

30 constructing a routing table at the primary routing communication protocol stack from the received identification of the connections to the VIPA so as to provide routing path information for the connections; and

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routing messages on the connections to the VIPA to the communication protocol stacks associated with the connections through the primary routing communication protocol stack utilizing the constructed routing table.

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17. A system for recovering from a failure of a primary routing communication protocol stack which routes communications over connections to a virtual Internet Protocol address (VIPA) and at least one port associated with the VIPA to a plurality of other communication protocol stacks associated by the routing communication protocol stack with the VIPA and the at least one port, comprising:

means for identifying at least one of a plurality of communication protocol stacks other than the primary routing communication protocol stack in a cluster of data processing systems containing the primary routing communication protocol stack as a backup routing communication protocol stack;

means for storing at the backup routing communication protocol stack an identification of communication protocol stacks associated with the VIPA and the at least one port as candidate target stacks;

means for receiving messages at the backup routing communication protocol stack identifying ones of the communication protocol stacks having application instances bound to the VIPA and listening on the at least one port as current actual target stacks;

means for identifying connections to the VIPA and the at least one port for current actual target stacks;

means for constructing a routing table from the received messages identifying the connections to the VIPA so as to provide routing path information to current actual target stacks associated with the connection; and

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means for routing messages on the connections to the  
VIPA and the at least one port to the current actual  
target stacks associated with the connections through the  
backup routing communication protocol stack utilizing the  
constructed routing table.

18. A system according to Claim 17, wherein the  
means for identifying connections to the VIPA comprises  
means for receiving messages from the current actual  
target stacks identifying connections to the VIPA and the  
at least one port associated with the current actual  
target stacks.

19. A system according to Claim 17, further  
comprising:

means for receiving a list of communication protocol  
stack addresses which are associated with the VIPA and  
the at least one port; and

wherein the means for storing at the backup routing  
communication protocol an identification of communication  
protocol stacks associated with the VIPA and the at least  
one port as candidate target stacks comprises means for  
storing the received list of communication protocol stack  
addresses.

20. A system according to Claim 19, wherein the  
list further includes identification of the VIPA and  
ports associated with the VIPA.

21. A system according to Claim 17, further  
comprising:

means for defining, at the backup routing  
communication protocol stack, an identification of  
communication protocol stacks which are associated with  
the VIPA and the at least one port so as to provide a

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backup list of candidate target stacks which is different from the candidate target stacks of the primary routing communication protocol stacks; and

5 wherein the means for storing at the backup routing communication protocol an identification of communication protocol stacks associated with the VIPA and the at least one port as candidate target stacks comprises means for storing the backup list of candidate target stacks.

10 22. A system according to Claim 21, wherein the communication protocol stacks identified in the backup list of candidate target stacks are selected to reduce disruption of the cluster of data processing systems associated with the communication protocol stacks by  
15 failure of the primary routing communication protocol stack.

20 23. A system according to Claim 17, further comprising means for sending the stored list to the plurality of communication protocol stacks in the cluster of data processing systems.

24. A system according to Claim 23, further comprising:

25 means for transmitting messages to the backup routing communication protocol stack identifying ones of the communication protocol stacks in the cluster of data processing systems which are identified on the list and which have application instances bound to the VIPA and  
30 listening on the at least one port;

means for transmitting messages to the backup routing communication protocol stack identifying connections to the VIPA and the at least one port; and

35 means for associating the backup routing communication protocol stack with the VIPA and the at

least one port so as to send subsequent messages associated with the VIPA and the at least one port to the backup routing communication protocol stack.

5           25. A system according to Claim 17, further comprising:

          means for detecting recovery of the primary routing communication protocol stack; and

          means for transferring routing of connections to the  
10       VIPA and the at least one port back to primary routing communication protocol stack upon detection of recovery of the primary routing communication protocol stack.

15           26. A system according to Claim 25, wherein the means for detecting recovery and transferring routing comprise:

          means for receiving, at the backup routing communication protocol stack, an identification of communication protocol stacks associated with the VIPA  
20       and the at least one port which are being routed by the backup routing communication protocol stack from the primary routing communication protocol stack;

          means for associating the primary routing communication protocol stack with the VIPA and the at  
25       least one port at communication protocol stacks having connections to the VIPA and the at least one port or identified in the identification from the primary routing communication protocol stack as associated with the VIPA and the at least one port so as to cause subsequent  
30       messages associated with the VIPA and the at least one port to be sent to the primary routing communication protocol stack;

          means for identifying connections to the VIPA and the at least one port which are routed by the backup  
35       communication protocol stack;

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means for constructing a routing table at the primary routing communication protocol stack from the received identification of the connections to the VIPA so as to provide routing path information to current actual target stacks associated with the connection; and

means for routing messages on the connections to the VIPA and the at least one port to the current actual target stacks associated with the connections through the primary routing communication protocol stack utilizing the constructed routing table.

27. A system for recovering from a failure of a primary routing communication protocol stack which routes messages to a predefined virtual IP address (VIPA) to a predefined set of candidate target communication protocol stacks, comprising:

means for defining a backup routing communication protocol stack which takes ownership of routing functions for the VIPA in the event of failure of the primary routing communication protocol stack;

means for detecting failure of the primary routing communication protocol stack;

means for determining, at the backup routing communication protocol stack, connections to the VIPA which are associated with the primary routing communication protocol stack;

means for routing the determined connections to communication protocol stacks associated with the connections through the backup routing communication protocol stack;

means for establishing a second set of candidate target communication protocol stacks which is different from the predefined set of candidate target communication protocol stacks and associated with the backup routing communication protocol stack;

means for receiving a request for a new connection to the VIPA;

selecting a communication protocol stack from the second set of candidate communication protocol stacks as  
5 a destination for the new connection to the VIPA; and

means for routing messages associated with the new connection to the selected communication protocol stack through the backup routing communication protocol stack.

10 28. A system according to Claim 27, wherein the second set of candidate target communication protocol stacks are selected to reduce disruption of a cluster of data processing systems associated with the communication protocol stacks by failure of the primary routing  
15 communication protocol stack.

29. A system according to Claim 27, further comprising means for sending an identification of the second set of candidate target communication protocol  
20 stacks to other communication protocol stacks in a cluster of data processing systems.

30. A system according to Claim 29, further comprising:

25 means for transmitting messages to the backup routing communication protocol stack identifying ones of the other communication protocol stacks which have application instances bound to the VIPA and listening on a port of the VIPA;

30 means for transmitting messages to the backup routing communication protocol stack identifying connections to the VIPA; and

means for associating the backup routing communication protocol stack with the VIPA so as to send  
35 subsequent messages associated with the VIPA and the at

least one port to the backup routing communication protocol stack.

5 31. A system according to Claim 27, further comprising:

means for detecting recovery of the primary routing communication protocol stack; and

10 means for transferring routing of connections to the VIPA back to primary routing communication protocol stack upon detection of recovery of the primary routing communication protocol stack.

15 32. A system according to Claim 31, wherein the means for detecting recovery and the means for transferring routing comprise:

20 means for receiving, at the backup routing communication protocol stack, an identification of candidate target communication protocol stacks associated with the VIPA from the primary routing communication protocol stack;

25 means for associating the primary routing communication protocol stack with the VIPA at communication protocol stacks having connections to the VIPA or identified in the received identification of candidate target communication protocol stacks from the primary routing communication protocol stack so as to cause subsequent messages associated with the VIPA to be sent to the primary routing communication protocol stack;

30 means for identifying connections to the VIPA which are routed by the backup communication protocol stack;

35 means for constructing a routing table at the primary routing communication protocol stack from the received identification of the connections to the VIPA so as to provide routing path information for the connections; and

means for routing messages on the connections to the VIPA to the communication protocol stacks associated with the connections through the primary routing communication protocol stack utilizing the constructed routing table.

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33. A computer program product for recovering from a failure of a primary routing communication protocol stack which routes communications over connections to a virtual Internet Protocol address (VIPA) and at least one port associated with the VIPA to a plurality of other communication protocol stacks associated by the routing communication protocol stack with the VIPA and the at least one port, comprising:

a computer readable storage medium having computer readable program code embodied therein, the computer readable program code comprising:

computer readable program code which identifies at least one of a plurality of communication protocol stacks other than the primary routing communication protocol stack in a cluster of data processing systems containing the primary routing communication protocol stack as a backup routing communication protocol stack;

computer readable program code which stores at the backup routing communication protocol stack an identification of communication protocol stacks associated with the VIPA and the at least one port as candidate target stacks;

computer readable program code which receives messages at the backup routing communication protocol stack identifying ones of the communication protocol stacks having application instances bound to the VIPA and listening on the at least one port as current actual target stacks;

computer readable program code which identifies connections to the VIPA and the at least one port for current actual target stacks;

5 computer readable program code which constructs a routing table from the received messages identifying the connections to the VIPA so as to provide routing path information to current actual target stacks associated with the connection; and

10 computer readable program code which routes messages on the connections to the VIPA and the at least one port to the current actual target stacks associated with the connections through the backup routing communication protocol stack utilizing the constructed routing table.

15 34. A computer program product according to Claim 33, wherein the computer readable program code which identifies connections to the VIPA comprises computer readable program code which receives messages from the current actual target stacks identifying connections to  
20 the VIPA and the at least one port associated with the current actual target stacks.

35 35. A computer program product according to Claim 33, further comprising:

25 computer readable program code which receives a list of communication protocol stack addresses which are associated with the VIPA and the at least one port; and

30 wherein the computer readable program code which stores at the backup routing communication protocol an identification of communication protocol stacks associated with the VIPA and the at least one port as candidate target stacks comprises computer readable program code which stores the received list of communication protocol stack addresses.

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36. A computer program product according to Claim 35, wherein the list further includes identification of the VIPA and ports associated with the VIPA.

5 37. A computer program product according to Claim 33, further comprising:

computer readable program code which defines defining, at the backup routing communication protocol stack, an identification of communication protocol stacks which are associated with the VIPA and the at least one port so as to provide a backup list of candidate target stacks which is different from the candidate target stacks of the primary routing communication protocol stacks; and

10 15 wherein the computer readable program code which stores at the backup routing communication protocol an identification of communication protocol stacks associated with the VIPA and the at least one port as candidate target stacks comprises computer readable program code which stores the backup list of candidate target stacks.

20 25 38. A computer program product according to Claim 37, wherein the communication protocol stacks identified in the backup list of candidate target stacks are selected to reduce disruption of the cluster of data processing systems associated with the communication protocol stacks by failure of the primary routing communication protocol stack.

30 35 39. A computer program product according to Claim 33, further comprising computer readable program code which sends sending the stored list to the plurality of communication protocol stacks in the cluster of data processing systems.

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40. A computer program product according to Claim 39, further comprising:

computer readable program code which transmits messages to the backup routing communication protocol stack identifying ones of the communication protocol stacks in the cluster of data processing systems which are identified on the list and which have application instances bound to the VIPA and listening on the at least one port;

computer readable program code which transmits messages to the backup routing communication protocol stack identifying connections to the VIPA and the at least one port; and

computer readable program code which associates the backup routing communication protocol stack with the VIPA and the at least one port so as to send subsequent messages associated with the VIPA and the at least one port to the backup routing communication protocol stack.

41. A computer program product according to Claim 33, further comprising:

computer readable program code which detects recovery of the primary routing communication protocol stack; and

computer readable program code which transfers routing of connections to the VIPA and the at least one port back to primary routing communication protocol stack upon detection of recovery of the primary routing communication protocol stack.

42. A computer program product according to Claim 41, wherein the computer readable program code which detects recovery and transferring routing comprise:

computer readable program code which receives, at the backup routing communication protocol stack, an

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identification of communication protocol stacks  
associated with the VIPA and the at least one port which  
are being routed by the backup routing communication  
protocol stack from the primary routing communication  
5 protocol stack;

computer readable program code which associates the  
primary routing communication protocol stack with the  
VIPA and the at least one port at communication protocol  
stacks having connections to the VIPA and the at least  
10 one port or identified in the identification from the  
primary routing communication protocol stack as  
associated with the VIPA and the at least one port so as  
to cause subsequent messages associated with the VIPA and  
the at least one port to be sent to the primary routing  
15 communication protocol stack;

computer readable program code which identifies  
connections to the VIPA and the at least one port which  
are routed by the backup communication protocol stack;

computer readable program code which constructs a  
20 routing table at the primary routing communication  
protocol stack from the received identification of the  
connections to the VIPA so as to provide routing path  
information to current actual target stacks associated  
with the connection; and

25 computer readable program code which routes messages  
on the connections to the VIPA and the at least one port  
to the current actual target stacks associated with the  
connections through the primary routing communication  
protocol stack utilizing the constructed routing table.

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43. A computer program product for recovering from  
a failure of a primary routing communication protocol  
stack which routes messages to a predefined virtual IP  
address (VIPA) to a predefined set of candidate target  
35 communication protocol stacks, comprising:

a computer readable medium having computer readable program code embodied therein, the computer readable program code comprising:

5 computer readable program code which defines a backup routing communication protocol stack which takes ownership of routing functions for the VIPA in the event of failure of the primary routing communication protocol stack;

10 computer readable program code which detects failure of the primary routing communication protocol stack;

computer readable program code which determines, at the backup routing communication protocol stack, connections to the VIPA which are associated with the primary routing communication protocol stack;

15 computer readable program code which routes the determined connections to communication protocol stacks associated with the connections through the backup routing communication protocol stack;

20 computer readable program code which establishes a second set of candidate target communication protocol stacks which is different from the predefined set of candidate target communication protocol stacks and associated with the backup routing communication protocol stack;

25 computer readable program code which receives a request for a new connection to the VIPA;

selecting a communication protocol stack from the second set of candidate communication protocol stacks as a destination for the new connection to the VIPA; and

30 computer readable program code which routes messages associated with the new connection to the selected communication protocol stack through the backup routing communication protocol stack.

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44. A computer program product according to Claim 43, wherein the second set of candidate target communication protocol stacks are selected to reduce disruption of a cluster of data processing systems associated with the communication protocol stacks by failure of the primary routing communication protocol stack.

45. A computer program product according to Claim 43, further comprising computer readable program code which sends an identification of the second set of candidate target communication protocol stacks to other communication protocol stacks in a cluster of data processing systems.

46. A computer program product according to Claim 45, further comprising:

computer readable program code which transmits messages to the backup routing communication protocol stack identifying ones of the other communication protocol stacks which have application instances bound to the VIPA and listening on a port of the VIPA;

computer readable program code which transmits messages to the backup routing communication protocol stack identifying connections to the VIPA; and

computer readable program code which associates the backup routing communication protocol stack with the VIPA so as to send subsequent messages associated with the VIPA and the at least one port to the backup routing communication protocol stack.

47. A computer program product according to Claim 43, further comprising:

computer readable program code which detects recovery of the primary routing communication protocol stack; and

5 computer readable program code which transfers routing of connections to the VIPA back to primary routing communication protocol stack upon detection of recovery of the primary routing communication protocol stack.

10 48. A computer program product according to Claim 47, wherein the computer readable program code which detects recovery and the computer readable program code which transfers routing comprise:

15 computer readable program code which receives, at the backup routing communication protocol stack, an identification of candidate target communication protocol stacks associated with the VIPA from the primary routing communication protocol stack;

20 computer readable program code which associates the primary routing communication protocol stack with the VIPA at communication protocol stacks having connections to the VIPA or identified in the received identification of candidate target communication protocol stacks from the primary routing communication protocol stack so as to  
25 cause subsequent messages associated with the VIPA to be sent to the primary routing communication protocol stack;

computer readable program code which identifies connections to the VIPA which are routed by the backup communication protocol stack;

30 computer readable program code which constructs a routing table at the primary routing communication protocol stack from the received identification of the connections to the VIPA so as to provide routing path information for the connections; and

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computer readable program code which routes messages  
on the connections to the VIPA to the communication  
protocol stacks associated with the connections through  
the primary routing communication protocol stack  
5 utilizing the constructed routing table.

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